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Epidemic Intestinal Diseases
in Albany and Vicinity.

BY

JOSEPH D. CRAIG, A.M., M.D.,

ALBANY, N. Y.,

*Lecturer on and Demonstrator of Anatomy
in the Albany Medical College.*

Semi-Annual Address delivered before the
Medical Society of the County of
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EPIDEMIC INTESTINAL DISEASES IN ALBANY AND VICINITY.*

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Mr. President :

I desire to offer in this address, in fulfillment of my obligation as vice-president of this society, the results of a collective investigation into the causes of epidemic intestinal diseases, which have prevailed in Albany and vicinity during the months of December, 1890, and January, February and March, 1891. In response to a circular letter (see appendices Nos. 1 and 2) sent by me to known members of the medical profession in the counties of Albany, Rensselaer, Schenectady, Columbia, Greene, Schoharie, Saratoga, Herkimer, Fulton and Montgomery and to others living in the counties of Clinton, Essex, St. Lawrence, Erie, Onondaga, Oneida, Otsego and Washington, *one hundred and eight* replies were received.

From the information contained in these replies and from information obtained by means of personal investigation and inquiry from other sources the conclusions formulated in this address have been derived. It was also my purpose to tabulate the answers returned, but owing to the difficulty in deciding upon a convenient and simple basis of classification this has been found to be impracticable. A number of facts, concerning like epidemic diseases occurring in England, which pointed very strongly to contaminated water as an efficient cause, have been excluded from consideration. Investigations in other places contributing to the support of other theories of causes have also been excluded as foreign to the purposes of this paper. It has not been my object to study either abstract propositions or general theories of causes, but the more simple

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purpose, of considering only those facts which gave indications of the sources of disease in the epidemic just past, has alone engaged my attention.

I have sought for an expression of professional opinion and have endeavored to make what seem to me to be reasonable inferences therefrom. It is an estimation of probability only, and it is reasonably certain that no method of scientific investigation into a subject of the character of the one to which our attention is drawn to-night can do more at this present time. At least, I do not know of any records which show with the exactness of science the relations of cause and effect in any epidemic like unto the one through which our people have just passed. Bacteriological studies and chemical analyses have contributed many valuable facts to the elucidation of the problem of the relation of water to the public health, but have failed, so far, to do more than to indicate the probabilities of the case. Such studies and analyses do not fall within the limits of this paper. Others are working along these lines and in due time will make public their results. By any method of investigation then, at present available, we can do no more than estimate probability. As the inductive method more often than the scientific one is, from necessity, the clinical method and produces valuable and approximately correct results, it is practicable for the purposes of this paper.

It has sometimes seemed to me as if the greater number of the profession had committed themselves to some *one* theory of cause of the epidemic just past, whereby they had become partisans and biased in their belief and had lost sight of the fact that either the severe gastro-intestinal inflammation or the typhoid fever might owe their origin in different cases to any one of a number of independent or contributing causes. It is, by reason of the multiplicity of these independent or contributing causes, acting separately or in combination, that this problem has become so complicated and so difficult of solution.

I think it is fair to say, so far as the purposes of this paper are concerned, that we have had prevailing in Albany and vicinity during the past winter

1. TYPHOID FEVER:

(a) *Running a typical course*, the proportion of these cases being to the whole number less than the average in other epidemics.

(b) *Running an atypical course* with one or more of the prominent symptoms of the disease absent. These cases comprise the greater number.

The case of Miss T. illustrates this type. In this case the fever wave of the first week was not typical of typhoid fever. There were no petechiæ; neither was there gurgling nor tenderness in the right iliac fossa. She died between the third and fourth week, and at the autopsy well-marked ulcerations of the patches of Peyer and enlargement of the mesenteric glands were found.

(c) *Of abortive forms*, with fairly typical onset and fever wave, but quickly receding about the second week.

2. MALARIAL FEVERS:

Almost exclusively prevalent in places away from the Mohawk and Hudson river centres of population.

3. OTHER FEVERS:

Not typhoid—probably due to sewer gas poisoning the specific cause and course of which are unknown.

4. LA GRIPPE:

The abdominal form of which principally concerns us in this address.

5. DIARRHŒAS:

With or without gastric or hepatic symptoms; of all grades of severity; owing their origin to well known causes, being

(a) *Irritative*—due to improper food, impure water, etc.

(b) *Symptomatic*—particularly of typhoid fever, acute enteritis and la grippe.

(c) *Vicarious*—from exposure to cold and wet and from sudden changes in temperature.

6. CATARRHAL ENTERITIS:

With or without gastric symptoms—especially prevalent in Schenectady and in other places among people who had contracted the disease in Schenectady.

The type of this variety of enteritis is somewhat different from the ordinary form. The disease is more chronic, more angry, more severe than usual. I have called it for convenience the Schenectady type. In these cases, as a class, there are these peculiarities:

1. Subnormal temperature.

2. Resistance to the treatment usually effective in this class of cases.

3. Marked tendency to persist.

4. Liability to recurrence, and

5. Perhaps spreading by contagion.

The following cases, briefly reported, will illustrate this type :

I.—Fred D., of Albany, age eighteen, a strong, healthy young man of good habits, went to work for the Edison Company in Schenectady on January 12th, 1891. He secured board first on Union Street and afterwards on Nott Terrace. Drank copiously of the Mohawk river water at both places, but especially drank the Mohawk water at the Edison works. This water was always dirty and of bad odor, and increased rather than diminished thirst. Had more or less diarrhœa until January 21st, when he was suddenly attacked with marked and severe gastro-intestinal symptoms, suffered great pain, was greatly prostrated and had almost constant vomiting and purging. The discharges were thin, mucous, and very offensive. Reached home the same day in a state of profound collapse. From this date to January 27th, just about a week, it was impossible for him to retain even a few drops of water on his stomach. Remedies usually effective in these cases were useless with him. The temperature taken every morning and evening was subnormal during the entire time. On two afternoons there appeared to be a slight rise in temperature, but of this I am not certain. After the more acute symptoms had subsided and he began to get about again, his diarrhœa still persisted and continued for weeks, marked by several periods of frequent and painful discharges. The stomach only resumed its full physiological activity after a period of several weeks.

This case well illustrates the Schenectady diarrhœal disease among those who drank of the Mohawk river water, irrespective of other conditions.

II.—William D., Albany, age seventeen, also a strong and healthy young man, went to work for the Edison Company and drank freely of the Mohawk river water. Suffered from profuse, painful, long-continued and rebellious diarrhœa, but of less severe character than Fred D. in Case I. There was the same marked persistency and tendency to recurrence. All symptoms gradually subsided after a number of weeks following his return to Albany.

III.—Ralph S., Albany, age seventeen, another perfectly healthy young man, went to work for the Edisons about February 1st, 1891. Boarded first on Union street and afterwards on Hulett street. Drank well water at Hulett street, none at all at Union street. Drank Mohawk river water at the Edisons on the same days on which he drank well water in Hulett street. States that the Mohawk river water was always dirty, and increased rather than diminished thirst. Two days after going to Hulett street was taken sick. Sick-ness began with headache followed by profuse and painful diarrhœa of very offensive substances. Had rise in temperature with accompanying thirst. The next day vomited greenish, bilious material. Acute symptoms rapidly subsided, but diarrhœa persisted for some time. With the exception of the rise in temperature the other characteristics of the disease were present.

Cases I and II seem to point to the Mohawk river water drank by these young men as a cause. Case III is valueless in the estimation of causes. The Hulett street well was known to be infected, as a man living in the same house and drinking well water exclusively had been sick with typhoid fever for two months, and a woman also living in the same house, also using this well water, was taken sick shortly afterwards. There was no sewer connection in these cases.

IV.—A large number of cases, reported verbally by Dr. Pearson, of Schenectady, whose accuracy as an observer none of us will question, all showed the same tendency to persistency, rebelliousness and subnormal temperature, and in one of which the prostration was so profound that death resulted.

V.—A case reported at Broadalbin, imported from Schenectady, kindly furnished by Dr. Finch. "This case," to use the doctor's own words, "has been a very severe and protracted form of diarrhœa, with attacks of vomiting once or twice a week. He has had no fever during the attack. He drank the Mohawk river water at Schenectady."

VI.—A case reported at Saratoga Spa.—"A locomotive engineer, whose duty kept him between Saratoga and Whitehall, used drinking water at various stations. The diarrhœa was severe, also had pains in his bowels. Great prostration followed first attack, with a tendency to return of bowel trouble if strict attention to diet and rest was not adhered to. * * * This patient's wife also had a slight attack. No other cases in Saratoga."

VII.—Dr. Rivenburgh, of Middleburg, reports three cases imported from Schenectady, "severe in form, with vomiting and purging. Cases of local origin, mild."

VIII.—Cases reported by Dr. Chas. McCulloch:

1st. "J. S. W., employe on Schenectady branch of D. and H. C. Co., drank a large quantity of Mohawk river water and in a few hours was attacked with diarrhœa, which has persisted until February 20th, 1891, a period of two weeks."

2d. "A large number of Italians, similarly affected from the same source, mostly acquired in Schenectady. *In any event, all drank Mohawk water.*"

IX.—Cases reported by Dr. J. C. Still:

Mild cases of diarrhœa occurred in his practice of home origin and some imported from Schenectady. Every one of a number of young men who went to Schenectady suffered. Cases protracted, convalescence slow.

X.—Four cases reported by Dr. J. F. Wheeler, of Chatham:

"These cases were imported from Schenectady among young men who went to work for the Edisons and drank Mohawk river

water. They recovered rapidly under treatment and change. All returned to work again. Three drank distilled water from the exhaust and remained well. *One drank the old water, relapsed and recovered again on returning to Chatham.*"

XI.—Dr. R. H. Morey has observed in his cases "great weakness and lassitude and the unusual length of time in convalescing." Three or four of his cases were imported from Albany.

XII.—From Kinderhook the following was obtained:

(a) "Mrs. W., of Kinderhook, visited Schenectady for two days. Came home and was confined to bed with diarrhœa."

(b) "Mrs. H., from the West, stopped in some of the lower towns on the Mohawk, then at Hudson. Had profuse diarrhœa."

(c) "Nephew of Dr. W. came from the West and stopped at Schenectady about the middle of September. Had diarrhœa, which persisted as long as he remained in Schenectady. Yielded rapidly on coming to Kinderhook."

XIII.—Dr. Jesse Crounse, of Altamont, sends the information that in his cases the "type of diarrhœal disease is different from the usual." "Several cases imported from Schenectady."

It has been stated by several that this type of disease is contagious. The following cases point in that direction. The evidence, however, is not very strong.

I.—Case 6 above.

II.—Case reported by Dr. Ross Wilson, of Sandy Hill, to whom I am especially indebted for his great interest in this investigation. (Dr. Wilson sent out over two hundred circulars and his reply is of great value.) He reports the following facts as bearing upon the contagiousness of this diarrhœal disease: "A son, his wife and child visited his mother here. The first three contracted a painful diarrhœa in Albany. His mother was prostrated with the same disease a few days later."

III.—Cases of Dr. Rivenburgh, of Middleburgh:

1. "Mr. B. contracted diarrhœa while on a visit to Schenectady. His whole family suffered." "The cases imported from Schenectady were the most marked."

2. "Mr. O. went to Schenectady to seek employment, returned with diarrhœa and gave it to his wife, but of milder form."

3. "Mr. A. contracted diarrhœa in Middleburgh and his family escaped."

In other words, cases that came from Schenectady were followed by other cases in the families of those affected. Cases of local origin did not spread beyond the persons originally attacked.

There is one other fact which seems to bear out the theory of a specific contagious principle as the cause of this diarrhœa. Whenever the cases were treated with antiseptics, particularly bichloride

of mercury, then there was the most rapid recovery. This was noticed by several observers.

In considering the expressions of opinion contained in the replies, it is convenient to group the returns under the following heads:

1. Direct contagion.
2. Atmospheric influence.
3. Drainage and sewer gas.
4. River and other waters.

I.—DIRECT CONTAGION.

The question of the contagiousness of the Schenectady type of the diarrhœal disease has already been considered. The following has reference to the contagiousness of typhoid fever.

If the replies received are at all an indication of professional opinion, it is certain that the great majority of physicians either do not believe in the propagation of typhoid fever by direct contagion or treat such a means of communication with great suspicion. Of the one hundred and eight physicians who replied, *forty* expressed an opinion. Of these, *twenty-seven* do not believe in direct contagion as a cause of typhoid fever, while two were doubtful. Eleven considered direct contagion as an occasional cause, but in as much as three of these were from Schenectady, a city which is now well known to be in an extremely unsanitary condition, some allowance must be made for the accuracy of the observation. From perfectly reliable observers, however, information comes that some cases have been so traced. In one of these cases the patient had nursed a typhoid fever patient and was herself attacked with the disease. Causes other than direct contagion were excluded. It is very probable that in occasional instances typhoid fever may be thus acquired. A very few of the cases in the epidemic under consideration may be so accounted for, but direct contagion has not entered in any large degree as a causative factor.

II.—ATMOSPHERIC INFLUENCE.

The replies to the question of the influence of atmospheric conditions as a cause, do not furnish us much of interest or importance. *Forty-nine* expressed the results of their observation. Of these, *eleven* did not trace any connection between the atmospheric conditions and their cases, while *two* regarded such conditions as the sole cause. *Two* others regarded the atmosphere as loaded with

miasma and believed such a condition to be the cause. The remainder, *thirty-four* in number, were fairly united in the belief that sudden changes in temperature, particularly from extreme cold to warmer weather, with falling barometer and much dampness or rain, were immediately followed, not only by an unfavorable course in those already affected, but also by a marked increase in the number of new cases. These observations apply to both the diarrhœal disease and typhoid fever. As the action of such changes on the course and in the causation of disease is already well known, and as nothing especially new or conclusive was obtained on this point, it will hardly be profitable to spend more time in its consideration.

III.—DRAINAGE AND SEWER GAS.

The relation of drainage and sewer gas to the prevailing epidemic has excited considerable professional interest. Forty-three expressed an opinion. Of these, the physicians of twenty-three places in which there is surface drainage and the cesspool system, but no sewers, state that there was

Diarrhœa alone in fourteen places.

Typhoid fever alone in two places.

• Diarrhœa and typhoid fever in three places.

Neither diarrhœa nor typhoid fever in four places.

Of thirteen places in which there were public sewers, there was diarrhœa alone in one place.

Typhoid fever alone in one place.

• Diarrhœa and typhoid fever in seven places.

Neither diarrhœa nor typhoid fever in four places.

These figures mean practically nothing, and from them practical deductions cannot be made.

In addition the following facts were obtained :

1. In Little Falls, where the sewers are new and privies abound, there has not been an unusual amount of either typhoid fever or diarrhœa. Almost every case of typhoid fever was imported from Albany or Schenectady. The drinking water is obtained from springs.

2. One case of typhoid fever is reported from Gloversville as caused by an untrapped sewer emptying into a creek.

3. One case of typhoid fever out of seven in Greenwich was due to a country drain.

4. Dr. Willard, of Catskill, reports "one case of typhoid fever in a family in which a broken sewer was found under the house."

5. Dr. Nellis reports two cases of typhoid fever as due to sewer gas.

6. Dr. Burton, of Troy, "has found that whenever the streets of that city are torn up to relay broken sewers, along the line of such sewers much typhoid fever always prevails."

7. Dr. Hennessey reports *two* cases in which defective drains were apparently the cause, while on the other hand he also reports *five* cases in houses in which there were no sewer connections at all.

From this information it is reasonable to infer that some of the cases, at least in the epidemic we are considering, were due, directly or indirectly, to sewer gas. I do not know that attention has ever been drawn to one strong argument against the theory of sewer gas as a prime factor in the causation of the epidemic. It has been abundantly substantiated that wherever there is a broken drain or improperly trapped or ventilated, or in any way defective system of plumbing, there there will be found a vitiated and poisonous atmosphere. Any human being inhaling such contaminated air will suffer in greater or lesser degree from its debilitating influence, and a proportion of these will be in such a non-resistant condition as to readily acquire any of the specific diseases, from whatever source derived, when brought within the range of their influence. I believe, in view of the strong evidence which follows, pointing to the drinking water as the great causative factor, that this is the best explanation of the fact that in so many houses in which typhoid fever has been found, the inspectors of our board of health have discovered incompetent drainage systems.

IV.—WATER.

The facts obtained in relation to water supply are of vastly more importance. There were fifty-nine returns in all, which can be fairly classified as follows:

1. Wherever spring or lake water was used exclusively (ten places in all), irrespective of sewerage system or drainage and irrespective of atmospheric conditions of the most diverse kinds, in every one of such places there was neither diarrhoeal disease nor typhoid fever.

2. Wherever the water supply was derived from wells, there there was found either diarrhoea or typhoid fever or both.

3. Wherever river water was used from head waters, or only slightly contaminated as shown by chemical tests, there there was neither diarrhoea nor typhoid fever.

4. Wherever there were centres of population placed near together, using river water contaminated largely with sewage from places above, there there was both diarrhœa and typhoid fever.

Three other factors in the water problem were also developed from this investigation.

1st. That rivers, and particularly wells, filled with the water that had been washed from the surface after abundant rain, the soil being so thoroughly frozen as to prevent absorption, were most active agents in causing an irritative diarrhœa. This diarrhœa was of the ordinary character and was not of that severe, chronic and rebellious nature which distinguished the Schenectady type. The water contaminated with the decomposing animal matter of barnyards and fertilized and manured farm lands, was a more active agent than water polluted simply with the products of vegetable decomposition. Diarrhœas thus caused made their appearance in January, immediately after the warm weather and heavy rains of that time. Through December the weather was continuously cold enough to prevent thaws. The Schenectady type of diarrhœa began about the first of December and continued until about the middle of March, and did not seem to be influenced in any marked degree by any atmospheric changes.

2d. That the statement that rivers, filled to overflowing after heavy rains and great thaws, contain the germs of disease diluted in a great degree, is found to be fallacious. These rivers do not contain large volumes of water with a proportionately less number of germs, but as shown in 1st, above, are filled with large volumes of water, polluted with a proportionately larger number of germs, washed from the soil.

3d. That rivers contaminated with sewage and covered with ice, were more dangerous as sources of water supply, through insufficient aëration of the contained water, than when open. Among men engaged as boatmen during the summer and as ice cutters during the winter, and drinking river water at all seasons, it was distinctly observed that such men were free from diarrhœal disease in the summer, but were largely affected in the winter.

IMPORTED CASES.

One other important factor deserves careful but brief consideration before gathering together the facts obtained from the returned circulars. In very many of the places reporting cases of severe diarrhœa and typhoid, there were none, or few, of home origin, but all, or nearly all had been imported from other places. The cases

of diarrhœa of home origin were of ordinary and mild type. The cases of diarrhœa from Schenectady, Albany, Cohoes and West Troy were of that severe and angry form which characterized the Schenectady type. *Thirty-six* physicians reported such cases. The figures are decidedly suggestive. There were imported from

1. Albany, *seventeen cases*, with *two* others reporting some (number not stated).

2. Schenectady, *forty-four cases*, with *seven* others reporting some (number not stated).

3. West Troy, *three cases*.

4. Cohoes, *three cases*.

5. Hudson, *one case*.

In addition, cases were reported

1. Among railroad men using water at Albany, Schenectady or Cohoes.

2. Among broom makers, using river water at Schenectady.

3. Among men engaged in ice cutting on the Hudson river in the neighborhood of the Abbey and Van Wie's point, both places being situated on the Hudson river just below Albany. Three physicians in three different places observed such cases. These men drank Hudson river water. At least forty per cent of the men cutting ice and drinking the river water at Van Wie's point had either typhoid fever or severe diarrhœa. The greater number had diarrhœa of the Schenectady type.

From *all other places* only *nine* cases were reported as imported. At least one hundred cases, of which sixty-seven are actually known and the rest conservatively estimated, were from Schenectady, Albany, West Troy or Cohoes. Considering the entire number of returns, this is a very large number, and there is something very suggestive in these figures.

THE FOUNTAIN AND ORIGIN OF THE EPIDEMIC.

It has been suggested that Schenectady was the fountain and origin of the epidemic under consideration, and that the pollution of the waters of the Mohawk river, by the sewage of that city, acting with other contributory causes, was the source of the epidemic diseases prevalent in Cohoes, West Troy and Albany during the past winter. There are very many facts which point to the truth of this suggestion.

Along the Mohawk river, Rome, Utica, Little Falls, Fonda and Amsterdam now use spring water almost exclusively as a source of

public supply, except the city of Rome, which derives its supply from the head waters of the Mohawk, where pollution is not likely. In all these places there has not been even the usual amount of diarrhœa and typhoid fever. At Utica, Little Falls and Amsterdam the sewage empties into the Mohawk river. At Rome and Fonda the drainage is the surface and cess-pool system. Sewer gas and defective drainage has certainly not caused either of the prevailing epidemic diseases in these places.

From Amsterdam, the city next above Schenectady, there could have been no pollution, as there have been but few cases of the epidemic diseases which have afflicted the lower cities. Moreover a flow of seventeen miles would be amply sufficient to purify the waters of the very slight sewage contamination through aeration, oxidation and precipitation. In fact, chemical analysis of the Mohawk river water, just above the city of Schenectady, has shown that it is comparatively free from chlorides and albumenoid ammonia.

In this connection, an instructive lesson is taught by the history of the water supply of the city of Amsterdam, kindly furnished me by Dr. Charles Stover. The sewerage has not been of the best until recently. The surface water has collected in places, owing to the inequalities of the roads and inefficient grades, and the sewers have been broken and incompetent. There are also some cess-pools. In spite, however, of the sewage system, the waves of contagious disease, particularly typhoid fever, have risen and fallen with the changes in the water supply. During the use of water derived from the old water system, there were only a small number of cases of typhoid fever; but there were some. The water so supplied was derived from a water-shed, and flowed along a natural creek, through pasture and farm lands. This water was analysed by Dr. Tucker and found to be polluted by animal matter, though not to a great extent. This water was not very pleasing to the eye, but, during its use, only a moderate amount of fever prevailed. In 1890, the reservoirs failed and the water commission shut off the supply from that source. Old wells, known to be contaminated, were now resorted to, when there was an immediate and alarming increase in the number of cases of typhoid fever, amounting to an epidemic. Soon after water from a new source became available, and its introduction was followed by a steady and marked decrease in the number of new cases until this fever became infrequent and, practically, disappeared. This new source is from springs supplied by the

gravity system, in addition to which there is also a supply from a lake near Ballston Spa. This is a fairly conclusive history of typhoid fever due to contaminated water, the sewage system remaining practically the same during the entire time.

The Mohawk river towns, as far as Schenectady, were thus found to be free from the epidemic diseases we are considering. The Hudson river towns from the north, as far as West Troy, now demand attention.

Sandy Hill, Fort Edward, Lansingburgh, Waterford, Green Island and Troy have been free from the prevailing epidemic diseases.

Fort Edward and Sandy Hill are supplied with water from springs. In both places the drainage is by means of the surface system. In neither has there been unusual diarrhœa or typhoid, except four cases which were imported to Sandy Hill and one to Fort Edward.

Green Island (which is subject to the same atmospheric conditions as West Troy, lies contiguous to it, and is drained by the surface and cess-pool system) has also been free from prevailing diseases. This town derives its water from a basin on an island in the Hudson, after percolation, which practically excludes contamination.

Waterford and Lansingburgh, just above the city of Troy, have been also free from epidemic typhoid fever and diarrhœa.

The sanitary condition of the city of Troy is well known and needs only suggesting in this place. The water supply is from the Hudson, immediately above the state dam. The sewers are of all conditions and kinds, while the house drainage is of the many degrees of perfection or imperfection found in modern American cities. The atmospheric conditions are, practically, the same as those existing in West Troy, directly across the river, and in Albany, six miles below. The Hudson, with overflowing banks, has furnished, part of the time at least, the same mechanical conditions for the forcing of sewer gas into the houses as found at Albany. Yet, with the exception of imported cases, there has been, practically, neither diarrhœal disease nor typhoid fever in that city.

The chain of cities and towns beginning at Schenectady and ending at Catskill present a suggestive history.

The city of Schenectady, in which endemic typhoid fever has prevailed for years, takes its water supply from the Mohawk river, immediately below the entrance of a tributary creek known as the

Beinekill, the intake being situated just in front of the upper end of the city. This source of supply is used by only a portion of the inhabitants. A very large number of houses having no connection with the water mains are still supplied by the old wells, which are fearfully contaminated with sewage, and are in near relation to the privies. The soil surrounding these old wells is thoroughly saturated with decomposing animal waste.

The systems of drainage are four in number:

1. The "Memphis" system of sewers running through all the principal streets, and discharging their contents into the Mohawk, below the water-works intake. Only part of the houses, however, along the line of these sewers, drain into them. The system is flushed automatically at intervals during the day, and, as far as it is utilized, contributes largely to the public health. All evidence seems to point to the completeness and thoroughness of part of the system. Part of the system, however, unfortunately is incomplete, owing to irregularities in the grades thereby allowing the sewage to accumulate in places. In other places the sewers are reported to be broken. Houses draining into these sewers are relatively free from typhoid fever, though not from diarrhoea.

2. The cess-pool and surface systems, largely used in portions of the city, a source of pollution of the wells, and, together with the old privies, a constant menace to public health.

3. The sewage system of the Edison and Westinghouse companies, which is common to the two works, is complete and thorough in itself, but discharges its sewage into Beinekill creek, above described as a tributary of the Mohawk, at a distance of half a mile above the intake of the Schenectady water-works. This sewer, together with Cow Horn Creek, presently to be described, is a direct and absolutely certain source of contamination of the Schenectady drinking water. It appears to me to be morally certain that it is just here that the source of the epidemic of last winter is to be found.

It is only just and fair to say that the Edison Company is entirely free from responsibility for directly or indirectly contributing to the large amount of sickness among its employees. Through the kindness of Mr. Kreusi, superintendant of the works, I was permitted to inspect all the buildings of the company, and to study their sewage system. Of the thirty-six buildings, comprising the works at that time, only four have any relation to the drainage system. All their closets, except in the four buildings just mentioned, are outside the main buildings, and there are no sewer pipes running through or under

any of them. These closets are trapped and ventilated, and flushed at regular intervals. The four buildings in which closets were found were those used by their female employees. Each of these closets is flushed automatically whenever used, and their waste pipes are trapped and ventilated. The sickness among their employees seemed proportionally large, but, when it is remembered that from a third to a half of the working population of Schenectady are employed in these works, it is evident that the relative sickness was not larger among them than among Schenectady people of the same class employed in other places. Early in the epidemic, the Edisons, from necessity, supplied the same water to their employees as that supplied to the people of the city generally. This water was from the city water supply, drawn from the Mohawk, was dirty, of bad odor, positively contaminated with sewage, and was the certain cause of the severe diarrhœal disease among their men. Now, these men are supplied with clear and comparatively pure water, from a system of driven wells. The Edison Company has done its full duty to its men and to the public, and should be free from all responsibility.

4. The fourth system of sewage is the most dangerous of all. Running through the centre of the city, starting from the cemetery at Nott Terrace, in the western portion, is Cow Horn creek, which empties itself finally into the Beinekill, at a distance of only a quarter of a mile above the water-works' intake. Its course is winding; it is not covered in any way; and into it flows the sewage of perhaps a twelfth of all the houses in Schenectady; its water is contaminated and foul, shown to be charged with chlorides and albumenoid ammonia by chemical tests, and finds its way along the quarter-mile flow into the Mohawk almost directly above the Schenectady water-works' intake. It needs neither bacteriology nor chemistry here to prove a certain contamination.

It is not possible for me to lay all the evidence before you within the limits of this paper. But whoever goes over the ground with ordinary care will, I think, find the statement of Dr. Duryee, of Schenectady, to be true; that the Mohawk river water, polluted as above described, has been the cause of most of the diarrhœas, while the old wells have been the cause of most of the typhoid fever. It is not to the discredit of Schenectady to make these statements now, as its people are actively seeking reform in sanitary affairs.

Out of 85 cases of typhoid fever in Schenectady, in 84 well water was used. Among the Edison employees, who drank the river water, diarrhœas were almost universal, irrespective of other conditions.

Among five cases of the Edison employees who left Schenectady suffering from profuse diarrhœas and who recovered, *four*, on returning to work, drank only water from the exhaust and remained well; while the *fifth*, who also returned, but drank of the Mohawk water again, was again afflicted with severe diarrhœa. This is fairly conclusive evidence. It has been also reported that in some of the houses having the most approved system of drainage, but using river water, many cases of diarrhœa occurred. Most of the cases of typhoid occurred in houses with no sewer or water connections and in which well water was used.

As a still further proof of the firm conviction among all those who speak honestly upon the subject after a careful investigation, the following extract from the report of the water commissioners on the new or Van Slyke island supply is offered.

"In view of the experience of the past few years, it would seem to be a work of supererogation to set forth the necessity of a change in the city's water supply.

Whether it is considered as a muddy liquid, unfit for drinking, washing or culinary purposes, filling up the mains and service pipes with sediment and lessening their capacity, or whether it is considered in its sometimes tolerably clear and far more dangerous condition, contaminated to a greater or less degree by the sewage which is emptied into the Frog Alley river*—a constant menace to health, an injury to the prosperity of the city through the impression which has gone abroad and is steadily gaining ground of the unhealthfulness of the city (and which impression will not be removed by mere denial) from whatever point of view it is regarded, the necessity of a radical and immediate change is generally conceded."

Diarrhœal disease and typhoid fever became epidemic in Schenectady about the first of December, and numerous cases appeared in Cohoes, West Troy and Albany a week or two later. It would seem probable from this sequence of time, together with the other evidence, that the river water, contaminated at Schenectady, reached the lower centres of population, and after the usual period of incubation made itself felt.

The sanitary condition of Cohoes, so far as it relates to the subject under consideration, is briefly told as follows: The water supply of Cohoes is obtained from the Mohawk river in the neighborhood of Crescent, two miles above the city, and is furnished to the public through two resevoirs, known respectively as Nos. 1 and 3. The water from reservoir No. 1 was examined by Dr. Tucker on February 26,

* Frog Alley river is another name for Cow Horn creek, before described.

1891, and found to be contaminated. The water from reservoir No. 3 was also examined by the same analyst at the same time and found to be in such condition as to be positively unfit for use. As frequently happens when water is stored in reservoirs, in addition to any primary contamination, secondary pollutions from vegetable growths in the reservoirs themselves may occur. This happened in reservoir No. 3 in Cohoes. In addition to the original contamination of the Mohawk river water, still greater pollution occurred after this water had remained for a little time only in this reservoir. Clinically, also, it was observed that the portion of the city supplied from reservoir No. 3 was much more numerous affected with prevailing epidemic diseases than the portion supplied from reservoir No. 1.

The sewers of the city of Cohoes are ventilated and empty into the Mohawk below the falls. Their mouths are exposed, except at high water. Some of the houses in which cases of fever and diarrhœa occurred have no sewer connections. Others are known to be well plumbed, trapped and ventilated. Of fifty-eight patients reported by Dr. Featherstonhaugh, fifty-seven drank unboiled water and the other drank boiled water. These cases following are of interest: (1) "Mr. J., of Cohoes, uses boiled water. There are three young people in his house. One of these goes to school at Albany, drinks the water and promptly has typhoid. The others escape." (2) "At Northside, a suburb of Waterford, where there have been no cases of home origin, two imported cases occurred there, one, a boy, goes to school in Albany, and the other a school teacher, lives in Waterford but teaches in Cohoes. Both drink river water. Both have fever, their families escaping." Dr. Featherstonhaugh, who communicated the above facts, kindly furnished them during a very busy season and states that he could give more examples if he had the time.

The facts from West Troy bearing upon this matter are few in number, but most decidedly to the point. West Troy has a double water supply—the Hudson above Troy, and the Mohawk at Dunsback Ferry. After the first fifty cases of typhoid fever had been reported, the Board of Health ordered the Mohawk river water to be shut off; within thirty days the disease almost entirely disappeared. The superintendent of the water-works, at the end of that time, surreptitiously turned the Mohawk water on again. There followed a prompt and wide-spread reappearance of the disease. Ninety-five per cent. of all cases in West Troy, as reported by Dr. Van Vranken, used river water, and occurred irrespective of drainage of any kind. There are some sewers in West Troy, some cesspools,

and some surface drainage; the sewers empty into the Hudson.

The factors of the problem in Albany are well known, so far as local conditions are concerned. Albany has two sources of water supply—one from the Hudson, furnishing river water to all that portion of the city west of North Pearl street, and a second supply from Tivoli lake, the water flowing into which is collected through Patroon's creek. Arising from springs, Patroon creek is augmented as it flows through farm lands, by a water-shed. Almost all the cases of typhoid fever in Albany were found in the section of the city, west of Pearl street, using river water. The section east of Pearl street, using the Tivoli lake supply, was comparatively free from the disease. Out of 406 cases of typhoid and symptomatic fevers occurring during this epidemic, as reported by the health officer of Albany, 334 used unboiled and unfiltered river water, while 72 used either boiled or filtered water. About eighty per cent. of the cases used unboiled or unfiltered river water. Of the returns from Albany, all but three expressed themselves as believing the river water to be the chief cause. Of the three who expressed themselves otherwise, one said he had no opinion on the subject; one said water is positively not the cause; and one said, frankly, he "didn't know." Two other statements were made in this connection, "St. Agnes' school, where plumbing and drainage is perfect, and where the water has been boiled with great care (so that both the drinking water and sewer gas can be excluded as a cause), there were a very great many cases of diarrhœa, but there has not been a single case of typhoid fever. On the other hand, in the Albany Orphan Asylum, where the water was not boiled, there has been neither diarrhœa nor a single case of typhoid."

The diseases under consideration did not appear in epidemic form in Hudson, Coxsackie or Catskill. These places are all situated on the Hudson river. There is a flow of about twenty miles between Albany and Hudson. Catskill is still further down the river. In Coxsackie river water is not used generally for drinking purposes.

At Hudson, river and well water are used as a source of supply. Drainage is good into sewers emptying into the Hudson river. There were diarrhœas, beginning after the January thaw, but scarcely a case of typhoid fever.

At Coxsackie, where cistern and well waters are used, there was neither unusual diarrhœa nor typhoid fever, except among the ice cutters drinking river water.

At Catskill river water is mostly used, with some cistern and well water. Drainage is by means of public sewers in part, and in part by means of the surface system. There have been many diarrhœas following sudden changes in temperature, but no typhoid fever.

From the foregoing statements of facts, together with other facts, for the presentation of which there has not been time in this paper, all largely contributed through the kindness of the profession, I am led to the following conclusions. Excluding from consideration the abdominal type of la grippe and the diarrhœas caused by bad food and sudden changes in temperature, I believe the epidemic diseases prevalent during the past winter to have been due—

1st. To the following contributing causes:

(a) An ice-bound condition of the Mohawk and Hudson rivers, whereby contaminated water was not sufficiently aerated, and the destruction of such contamination by oxidation was prevented.

(b) Additional contamination occurring after thaws and rains, the earth being frozen and preventing absorption, and the surface accumulations of decomposing animal and vegetable materials being washed directly into rivers and wells.

(c) Non-acclimated persons drinking for the first time water to which they had not been accustomed.

(d) Polluted milk supply.—I am informed that a number of cases of typhoid fever, in Albany, occurred among people using milk obtained from the same milkman.

(e) Sewer gas acting as a debilitating agent, and, in occasional instances, as a direct cause.

2d. And to the following as a chief cause:

(a) Typhoid fever and diarrhœas endemic in Schenectady, caused by the use of either the polluted city water or private wells, or both.

(b) The water of the Mohawk contaminated by the city sewers of Schenectady, polluting the water supply of the city of Cohoes at the intake at Crescent above the Cohoes falls.

(c) The water of the Mohawk again contaminated by the city sewers of Cohoes below the falls and polluting the drinking water of both West Troy and Albany.

If I had any bias at all at the beginning of this investigation, it was in favor of the river water as a proper and healthful source of public supply. It is to me at least a most convincing argument that the above conclusions were forced upon me by the powerful logic of the facts obtained.

I thank you, gentlemen, for your interest in and attention to this somewhat lengthy address. My thanks are also due to my professional colleagues, whose responses made this address possible, and to personal friends in Schenectady, Cohoes and Albany, who generously supplied me with valuable information.

APPENDIX I.

NO. 12 TEN BROECK STREET, }
ALBANY, N. Y., *February 16, 1891.* }

DEAR DOCTOR—There have been prevalent in Albany and vicinity, since the first of January last, many cases of severe irritative diarrhœa and catarrhal enteritis with or without gastric symptoms. The same intestinal disturbance has been called, in some places, "Winter cholera." This form of disease has become so frequent as to amount almost to an epidemic, and, as a consequence, there has arisen great public and professional interest in the subject. At the same time typhoid fever and an anomalous variety of fever, accompanied by irregular chills, neuralgia, and gastric and intestinal symptoms, have become epidemic in this section of the state.

It has become a matter of importance, both to the public and the profession, to ascertain, if possible, the causes which have produced such diseases.

I have, therefore, volunteered to make a collective investigation of the subject and invite an expression of opinion from the profession in this section of the state. Full information is particularly desired from places using potable water derived from other sources than the Hudson and Mohawk rivers. The opinions expressed will be properly tabulated and presented at an early date in a paper to the profession in Albany. A copy will be furnished you, if you desire.

Your coöperation is desired, and the favor of an early reply to the questions in the enclosed blank earnestly requested.

Very truly yours,

JOSEPH D. CRAIG.

APPENDIX II.

COLLECTIVE INVESTIGATION AS TO THE CAUSES OF EPIDEMIC
INTESTINAL DISEASE IN ALBANY AND VICINITY.

- A—1.—Do diarrhœal diseases prevail in your practice to an unusual extent?
- 2.—What is the source of the drinking water in these cases?
River, well or other water?
- 3.—What unfavorable atmospheric conditions have these diseases followed?
- 4.—Were any of the cases contracted in other places? If so, where?

5.—What kind of drainage system have the houses in which these cases occurred, and into what does it empty?

6.—What is your opinion as to the cause of such diseases, particularly in reference to—

(a) Drinking water?

(b) Atmospheric influences?

(c) Other causes?

B—I.—Have you had, to an unusual extent, in your practice—

(a) Typhoid fever?

(b) Anomalous or other fevers?

2.—If so, what cause did you assign?

(a) Drinking water?

(b) Importation from other places?

(c) Direct contagion?

(d) Local sources of infection, as privies, cess-pools, sewers, etc.?

3.—Is there any known relation in your cases, or do you suspect any relation to exist between drinking water and drainage system?

C—Can you remember a previous epidemic of like intestinal disease, where like atmospherical conditions prevailed? If so, will you give particulars?

D—Will you kindly report any case where the relation of cause to the disease has been POSITIVELY ascertained?

E—Remarks:

From

